DOCUMENT RESUME

ED 276 757 TM 860 708

AUTHOR Andrews, David B.
TITLE Model for Improvement of Learning Using Topographic Mapping.
PUB DATE Apr 86
NOTE 19p.; Paper presented at the Annual Meeting of the American Educational Research Association (67th, San Francisco, CA, April 16-20, 1986).
PUB TYPE Speeches/Conference Papers (150) -- Reports - Descriptive (141)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS College Students; Grade 8; Higher Education; *Intervention; *Learning Disabilities; *Learning Processes; Locus of Control; *Models; Motivation; Neurological Organization; Personality Traits; Secondary Education; *Study Skills; Transfer of Training
IDENTIFIERS *Topographic Brain Mapping

ABSTRACT

The paper develops a method for learning improvement which incorporates the learner in the development of the learning/instructional strategy. To this end, a rate limiting model using topographical brain mapping as an educational intervention is presented. It is suggested that such intervention programs focus on those factors which are "rate-limiters" of learning and which can be changed most effectively in the short-term. These factors are divided into those which "enable" effective learning through making the learning resources of the learner function at full capacity and those which "enhance" learning through increases in learning potential. It is suggested that traditional "study skills" instruction has focused exclusively on attempts to enhance learning through the addition of learning techniques and strategies. Brain mapping is proposed as a valuable tool not only for enabling full use of existing resources, but for making available information which engages the learner in the development of the most effective enhancement strategies. Brief discussion follows of two preliminary intervention programs, one with learning disabled college students and the other with "underachieving" 8th graders. Some examples of information that is available with the brain mapping and some of the ways in which it can be used directly are given, and directions for further research are mentioned. (Author/JAZ)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED276757

Model for Improvement of Learning using Topographic Mapping

David B. Andrews
Brain Behavior Laboratory
The Ohio State University

ABSTRACT

A model is presented for the use of topographical brain mapping as a significant piece of educational interventions which seek to improve learning skills. It is suggested that such intervention programs focus of those factors which are "rate-limiters" of learning which can be changed most effectively in the short-term. These factors are divided into those which "enable" effective learning through making the learning resources of the learner function at full capacity and those which "enhance" learning through increases in learning potential. It is suggested that traditional "study skills" instruction has focused exclusively on attempts to enhance learning through the addition of learning techniques and strategies. Brain mapping is proposed as a valuable tool for not only enabling full use of existing resources, but making avialable information which engages the learner in the development of the most effective enhancement strategies.

Brief discussion follows of two preliminary intervention programs, one with learning disabled college students and the other with "underachieving" 8th graders. Some examples are discussed of the type of information that is available with the brain mapping and some of the ways in which it can be used directly. Some directions for further research are mentioned.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

D. B. Andrews

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

X This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

TM 860 709

BEST COPY AVAILABLE

Model for Improvement of Learning

To those involved in education the desireability of good learning may seem a cliche. Yet we do not measure good learning nor do we attempt to teach it in any systematic way; rather, we teach and measure the acquisition of specific skills and knowledges, while assuming that learning is a given (the clinging legacy of intelligence's semantic tyrrany) or that if the "basic skills" are acquired all else will take care of itself.

Let's put this in a somewhat different perspective. The average individual in our society will spend approximately 6 hours a day for 180 days for 12 years in school. This totals 12,960 hours of intentional instruction. If we charitably ignore the literature on time-on-task and assume that all these hours are fully occupied in directed and intentional instruction, and if we assume that in the average individual's lifetime roughly as much directed intentional instruction goes on outside school as in school, we have an estimate of approximately 25,000 hours of learning under the instruction of a self-conscious teacher (i.e. one who both has and accepts the some responsbility for the outcome of the instruction). If we assume that the average individual is awake for 16 hours a day and lives 75 years, there are roughly 423,000 hours in which an individual can be learning and doing with prior learning. When compared with the seemingly charitable estimate of the time in which another is responsible for an individual's learning we find that, even so, only 6% of waking time has the responsibility for learning in the hands of someone other than the learner. There can be little doubt that the overwhelming majority of the waking life of an individual is not under the directed instruction of another. Stated otherwise, the vast majority of the learning of an individual is in the hands of the learner - not a teacher. It is perhaps most pressing in times where social and informational change are occurring with unabating accelleration that the most valuable legacy of a quality education would be that the schooling has made the individual a good learner.

Rather than enumerate items which have been experimentally demonstated to correlate with better learning performance, I will approach the development of a model for inproving learning from a point of view which incorporates the learner in the development of the learning/instructional strategy. I do this not out of any disrespect for the literature, but out of a recognition that the experimental methods used and historical biases in the ways in which the question has been addressed preempt any significant role for the learner. The resulting collection of observations and conclusions are interesting and, no doubt valid, in their own domains. However, the numbers and diversity of the observations and their implications are exceptionally difficult to assimilate into a conherent framework and are subject to the abuses of overempahsis.

Attitude change literature, not to mention politics, make it clear that any idea which requires intricate explanation will have a difficult time making any impact. The experience of education in the 1960s and early 1970s is ample evidence of the power of simple ideas

in times of confusion (or as Brinton put it, "failure of nerve") (Ravitch, 1983). The model proposed here begins with a concept similar to that which motivated the educational experimentation of the 1960s but attempts to provide additional structure to assist in the understanding of a method for producing good learners. It should be noted that this work is in no way intended to be a total philosophy of education, but is to apply to the specific development of strategies and programs for the improvement of learning in individuals in educational settings so that they will be more likely to leave their formal education as, not only educated, but also good learners for the other 94% of their lives.

The initial assumption is that all people are learners. Except in cases of physical limitation all humans learn to walk. Except in the rare case of extremely severe neurological impairment all individual learn to understand and use a complex language with nothing other than functional exposure to a language. All individuals learn complex patterns of social interactions. While there is no question that the speed and quality of learning of these things varies considerably from one person to another, there is no question that these complex learnings occur quite spontaneously, in context, in the absence of any intentional instructional efforts, and have occured essentially the same way in all human cultures throughout recorded history. The fundamental conclusion which results is that there exists in all individuals a "readiness to learn" which is consummated when that individual encounters the various stimuli of the human world.

The early form of this readiness to learn is determined by the biological givens of each individual at birth. This neurological potential for learning is progressively altered through developmental changes and the accumulation of new knowledge, both proceedural and declarative knowledges. At any given time in the life of an individual there exists some maximum potential for learning which is the accumulated residue of neurological givens, inevitable maturational changes in those givens and the "wetware" additions and alterations which are the result of experience. It is important to note that those experiential alterations can affect learning capacity either positively (Enhancers are those things which increase capacity) or by interferring with the action of those factors necessary for full expression of current capacity (Enablers are those things necessary for full expression of current capacity. Deterrents interfere with the ability of the enablers to work). Having mastered the concept of number and the basics of arithmatic will "enhance" the learning of algebra; having learned that you are good at math will "enable" algebra learning, even if the actual neurological/developmental/ experiential potential for learning algebra is identical in both cases. Thus the potential for learning can be enhanced by the addition of new information - facts, skills, strategies, control processes, etc. and its effectiveness can be less than optimal due to limiters which prevent the full expression of the potential.

The concept of rate is somewhat more central in another area where control of complex interacting systems is quite critical to

basic life processes. In any biochemical reaction a large number of factors contribute to its rate. Biochemistry, like learning deals in complex interactive systems where we may be interested in changing the behavior of the whole system in order to produce a specific end result. The appropriate conceptualization for producing such changes is better established and accepted in chemistry than in learning.

The traditional and most prevalent mode of chemical intervention has been, and mostly continues to be, enlightened trial and error. We try what seems intuitively plausible from among the known options. We look for patterns from one body or another, one culture to another, one nutritional pattern or another, one medication or another, a set of side effects of another proceedure, etc. Once a good observer finds a promising lead a careful process of research establishes the accepted treatment proceedure for producing the specific desired result. Most approaches to learning improvement have followed the same basic pattern.

A more elegant solution has become more common in biochemistry. In this approach one first carefully establishes the characteristics of each of the contributors to the reaction and determines "under normal physiological conditions: which step/s or contributor/s limit the rate of the reaction. Efforts to alter the reaction can focus directly on the rate limiter(s). If that which limits the rate can be altered directly, the rate of the reaction will be under direct control. Thus the greatest control over the final state will come from the intervention.

This rate limiting model is certainly simple in concept, but it conceals a large number of subtle complexities which must not be overlooked. The successful use of this model for an intervention requires quite detailed and precise information on the complete workings of all the features of the system. Practically, rate limiting must be an evolutionary approach - a combination of the more precise and the ad hoc. As more details of the system are learned what was thought to be the rate limiter may be replaced by something which was previously unknown. The system may change so that a rate limiter is no longer a rate limiter. The desired outcome may change, including the tolerance of error so that an old rate limiter king falls. Of particular importance is the fact that a system can be in a position of ultrastability (Ashby, 1959) because of complex interactions of a large number of rate limiters. (Ideally pure and applied educational research should be in a dialogue producing some of the same sort of ultrastability.) When this happens a great number of individual changes in the system may each produce some movement in the desired direction. No one or two changes may produce all the change that is desired. In the extreme, what changes rate in one system may not produce the same effect in what was thought to be an analogous system because of the existance of features whose presence was unknown. Perhaps most importantly (for purposes of analogy with educational learning processes) no amount of change in a variable which is not a rate limiter will have any effect on the rate. If a system is working at its maximum rate without the addition of more "mathemapotion", no addition of heat will make any difference - unless

it makes more mathemapotion.

This rate limiting model offers intrigueing analogies with human learning - a complex arrangement of simultaneously necessary conditions which determine the state of the whole system - never mind any specific product of the system. In pursueing the analogy with learning, attempts to improve learning would be most efficient and effective if the efforts were made to identify and manipulate the rate limiter(s). To pursue the analogy a bit further, where cognitive psychology has sought to identify the various boxes which are to be connected in modeling the mind, a rate limiting approach must focus on the dynamics of transitions between the various "boxes" in the system.

As we move from the chemical to the educational domain, the details of the analogy become less useful. Factors unique to the practical nature of the human condition must gain a central role in the development of a model for improvement of individual learning through the manipulation of rate limiters.

1. Enhancers and Deterrents - Some rate limiters will be true limiters - i.e. preventing the system from doing what it is fully capable of doing; while other rate limiters will be the absence of information, experience, processes or controls which will alter the system and enhance its capacity.

2. Short-term and Long-term effects - Some rate limiters may be easily altered in the short term but produce no long term change. Some rate limiters will require long term intervention to produce the types of changes which will alter rate on a permanent basis. Attempts to alter learning by short term interventions should focus on those rate limiters which can be altered in the short term in ways which maximize the long term change.

3. Internal vs. External Control - In applying the rate limiting model to human learning, we must consider those things which are within the internal control of the learner and those which are unlikely to ever occur without external intervention. Like the nature/nurture controversy over origins of intelligence, the internal and the external are necessarily mutually interdependent and probably inseparable. To any who seek to assist learners in the improvement of their learning, the optimal strategy will focus on those external changes which produce the greatest change of rate for the least investment. The payoff comes in the 94% of the time where the individual has personal responsibility and control of learning.

4. Transfer - When attempting to produce improved learning it is often the case that the changes that are actually desired are at least somewhat different and occur in very different contexts than in the arena of original instruction. Optimal changes in rate limiters will not only produce the change at the time of the change, but will provide generalizable changes which will be used in appropriate ways on future occassions, in different and often unknown and novel situations.

Before developing a specific model for intervention the four factors identified above will be discussed further..

1. Enhancers and Deterrents are not necessarily easy to identify. The individual interpretation of the causes of their own

behavior is critical to the way in which a change in any feature of their environment will affect their performance (Attribution Theory, Heider, 1967, H. Kelley, 1967). Something that is an enabler in one situation may act as an enhancer in another. For the purposes of this research model it will be proposed that there are categories of factors which act as limiters and enhancers. Specific factors will be used only as examples of operationalizations.

Enhancers must start with "Knowledge structures," the biological, maturational and experiential residue of the phylogeny and ontogony of the individual. But these are the givens. Enablers will be anything which adds to the capacity of the individual to utilize these structures effectively. Ornstein and Naus' (1984) research makes quite clear that additional information which is presented in the proper fashion can elicit the spontaneous use of learning strategies which enhance effectiveness. Tversky and Kahneman (1978) make clear that procedural knowledge (heuristics), while they can produce erroneous performance, primarily will produce increase effectiveness when used in a domain appropriate fashion. Metacognitive training suggests that knowledge about "knowledge structures" can enhance the individual"s ability to learn (Andrews, 1984). One important item to include in the array of enabler is good models of learners. The work of Bandura (1971) and his followers of the social learning persuasion make clear that powerful changes in all realms of human behavior can come from exposure to models.

For purposes of making a distinction, it is assumed that learning occurs at an optimal level, given the existing knowledge structures, without concern for the deterrents. Thus, motivation, which all agree is necessary for performance, will be assumed to be an enabler. That is, the absence of motivation in the optimal amount can interfere with learning performance. The presence of motivation cannot make the system work beyond its capacity. The literature on attention, curiosity, motivation strongly suggest that, motivation is at the peak when the activity engaged in has the proper informational relationship with the knowledge structures. In other words, motivation is only an issue when the information to be learned is less than optimal for the existing structures. An enhancer strategy attempts to create the readiness to be motivated by the experience and learn it - e.g. add knowledge or specialized strategies. An enabler strategy tries to increase performance by the direct manipulation of motivation.

Deterrents will be considered to fall into two categories: first, self-concept; second, motivational. Self-concept, from this point of view cannot improve performance, a poor one, or self doubt, or low levels of aspiration can limit optimal performance. Specifically anything which is "self-alienating" will tend to divert you from those areas of learning activity that are most appropriate for your knowledge structures. Metacognitive knowledge will tend to be isotrophic and break down the modularities. In this sense, an inflated sense of self can lead you to believe you know that which you don't, not try any more, and learn less, just the same as a poor self-concept. The key feature in this first category of limiter is

self-alienation. In a very real sense, the knowledge structures you bring to a learning task are your self-as-learner. This includes not only the knowledges and processess (declarative knowledge and proceedural knowledge) which you possess, but the full complement of interrelationships among them and the executive processes which direct their execution. To the extent that there are pieces of that system which are isolated (alienated) from others there can be conflicts which interfere with the execution of the capacities which exist within. These are the internally controllable context effects which can be the mediators to produce greater generalization over time and thus more appropriate use of metacognitive information and executive processes when guided by a responsiveness to natural consequences (monitoring).

Thus the optimal learners must include the full range of factors usually included under personality. The full-functioning personality (self-actualized in Maslow's sense (1954)) will be a better learner than the fragmented and conflicted. One must be very careful when getting into the relationship between personality and learning to avoid confusing the optimal learning of that individual and the optimal learning of a given subject matter. There can be no doubt that an individual can do his or her optimal learning and do much more poorly on a specific task than they might with additional enhancement. Though it will not be a part of any study coming directly from this model, this strongly suggests that "therapy" in a reasonably traditional sense may be what is needed to modify a rate limiter in some, maybe many, cases. The other thing that is a potential confusion is the problem of the goal of learning. Who is setting the goal for the learning, using what criteria? For educational purposes we must assume that the goals and appropriate standards for attainment are primarily, if not exclusively set by individuals other than the learner. While this model is built on many assumptions about the natural functioning of man, it is not a Rousseauian Natural Man model. The internal models that can be so important in monitoring and automatiztion are not givens - they are acquired from experience, can be enhanced and be the basis for a trophic learning process (White, 1967).

The second conceptual category of deterrent is motivation. By motivation I mean an array of things that is somewhat broader than the traditional conceptions. In Luria's sense (Luria, 1973) I am talking about those things that produce the optimal level of arousal/attention in the first functional block. This will be directly related to allowing the other two functional blocks to operate in an optimal fashion - i.e. learn effectively. While inattention is an obvious problem, the opposite end of the arousal continuum - anxiety loosely speaking - will prevent performance at the level that one is potentially able..

2. Short-Term vs. Long-Term - Any intervention which seeks to increase learning efficiency has a number of potential rate limiters to address. An efficient investment of time would dictate that the intervention work in those areas where the greatest change can be produced in the least time. Therapy may be quite valueable, but it is

not the stuff of which a course on "study skills" is made and cannot fit into the same sort of position in a school curriculum. Knowledge structures are the sum of the totality of an individual's experience. An attempt to alter learning by adding specific facts to the knowledge base amy be quite important, but it is not something that can easily occur in a short time. This is the realm for changes in the curriculum and the attitudes and behaviors of parents and teachers - a worthy task, but a large one. Changing the dynamics of motivation may be quite important, but it is likely to be weak short-term strategy. It is the assertion of this model that the greatest positive change in the direction of long-term learning enahncement can come from changes to executive processes (permitting the application of varied strategies to learning), reduction in self-alienation (removing some of the impedance to the full utilization of the resources that are available - including the enhancements to executive processing), and developing of goal setting and monitoring skills.

3. Internal vs. External - Good learners have are likely to have an internal locus of control (Rotter,1966) which will incline them to pursue alternatives when learning is unsuccessful, make them more likely to organize and direct their own learning, and more active in the selection of learning strategies which they feel appropriate for them in the task (Biggs, 1984). One with a sense of external control is more likely to be a passive learner who quits easily and makes little effort to alter the circumstances or him/herself in relation to the learning task. A good program of learning improvement needs to provide the individual with the feeling that he/she has control over learning processes and has choices available that will provide success.

4. Transfer - The literature on transfer is enormous to say the least. The standard finding in learning theory and research has been that the more similar the situation is which the learning is to the situation in which the later learning /or performance is, the greater the transfer. Cognitive psychology has tended to hue to the same position, but with the addition that various internal mediational processes can create similarity of situation in the head when it doesn't exist in the external circumstances. Thus, for example, imagining yourself doing what you are learning in the situation in which you want to do it in the future can mediate the transfer from one situation to a relatively different one. Having an internal cueing mechanism could do the same - the teacher says you can learn history better by X; you recall that whenever you identify that you are trying to learn history you should do X. All you need to do to get yourself in a postion to use this new technique is notice that it is history and you are trying to learn. The research on transfer of metacognitive learning is mixed, and only slightly encouraging. Those cases where there is the best evidence of transfer are those in which motivational/affective tactics are used (e.g.McCombs, 1984). It should be noted that these experiments are with very narrowly defined learned tasks and occur over very short periods of time. One interesting possibility is that mediation of transfer will occur by reducing of self-alienation. Those processes that are the essence of

self-alienation are compartmentalizations which restrain generalization (beyond the modularity of Fodor(1985), but similar to that discussed by Gazzaniga(1985) with regard to belief). To the extent that some degree of "decompartmentalization" can occur, it would be expected that learning processes would tend to generalize bettter - thus transfer to more task appropriate situations. Good learners tend to be much more fluid in their learning approaches. It is also possible that this process could be enhanced by having the individual, while not just a big happy cerebrum of harmony, have a fluidity of processes which can be utilized to bridge gaps, as necessary. Thus, for example, individuals who have the capacity to utilize more than one member of a dichotymous learning style pair have the option of selecting the approach that is most useful for the task they are engaged in or the domain of their knowledge structures they are utilizing.

This model for learning skills improvement presumes the ideal program will require substantial change in teacher education, curriculum, parent attitudes, organizational and administrative structure in school - all of which require major long term efforts. The interventions that are likely to produce the greatest changes of "rate" in the short term intervention must:

1. Seek to produce the maximum potential for continued self-directed learning skills improvement.
2. Give the individuals the greatest possible enhancement of control over their own learning.
3. Focus on the rate limiters (enhancements or deterrents) - as best we can identify them.

Based on the preceeding oversight of the literature, those areas which seem prime candadites as rate limiters and offer apparent opportunity for successful short-term intervention include:

1. Knowledge of, and successful experience with, a variety of learning strategies.
2. Self-monitoring skills: setting goals and monitoring progress toward those goals.
3. "Enabling" - removal of blocks to effective performance; self-doubts, proto-learned helplessness, tactics for dealing with frustration and anxiety, reduction of self-alienation.

The social and personal context in which such an intervention will be successsful includes the following features:

1. Since it is assumed that long term effects will come from natural consequences, short-term effects will increase if the greatest possible authority is attached to the information. This is particularly true with brain information which shows the learner
    a. that he/she has a brain that works
    b. that the brain has strengths
    c. that the strengths, when used result in improved learning
2. Learning skills instruction is done in relation to types of learning interesting to the individual.

3. The learning of executive control be pursued as rapidly as possible, but the individual set the pace.
4. Successes be maximized. Make attributions individual and to processes and effort.
5. The Hawthorne Effect be used to its fullest - make the learners believe there is something special about them and/or the instruction they are getting.
6. Let the instructor be an effective model - a person they can respect, but who shows and externalizes the learning processes that are used.
7. Learning should be in as natural a situation as possible. Natural consequences should be available as much as possible.

The following is a sequencing of steps that would reasonably be followed in a learning skills instructional program. There will be no discussion of needed changes in teacher education, selection or evaluation, or in curriculum.

1. Begin with introduction of "representation" options instruction, goal selection probing and self-monitoring questions from the beginning of elementary school. Much of what is sought will happen if individuals are just asked to examine how they are doing things, and not just what they are doing. This will also include exposing students to direct examples and modeling of executive statements.

2. With any student who is not fully successful in any basic area a standard neurocognitive assessment will be given. This is intended to be of the same order as current assessments for "identification" but will be for anyone who is perceived as having any difficulty in any basic area. With the development of neurocognitive expertise and assessment techniques described above such evaluations will be relatively quick and easy. Initially these assessments would include a standard assessment battery. As brain mapping technique is refined and protocols of educationally relevant tasks are developed, the complete assessment can be built around the brain mapping.

Results of these assessments will be shared with teachers and parents so that they can understand strengths of individuals which can be used as the basis of more effective learning strategies. With older children more of the specific information about the assessment can appropriately be shared. For purposes of keeping the assessment intelligible, it will be best to use Luria's model, using amplitude as an index for block one, right-left differences for block two, and front-back differences for block three. As techniques get more precise it may be possible to move to more refined assessment; but since many types of learning tasks will be a part of the protocol, the differences in the three blocks can be seen in varied learning and performance areas.

3. During Middle School each student will take a learning skills course which will be designed to formalize the information which was given indirectly in elementary school. In particular, there will be familiarization and practice with learning strategies and executive processes, work on goal setting and self-monitoring, and problem-solving in natural situations.

Students who are experiencing difficulty would be candidates for a neurocognitive assessment. At this point the results would be shared with the individual for interpretation and the development of strategies for the future.

The attached protocol (Table 1) currently in use in research in the Brain Behavior Lab, will provide an indication of tasks which could be included in a standardized assessment. With time, a composite protocol can be developed, the numbers of tasks will be reduced and tailored to specific assessment purposes. In all work the active participation of the assessed individual in the selection of tasks to assess should be used to give them an active role and a favored position in interpretation. Given the variety of learning styles, subject matters and goals it should never be assumed that any protocol is comprehensive or final.

The goal of this program is not only to improve the learning of individuals who participate, but through the authority of the direct assessment of the brain's activity to influence parents, teachers and students toward more realistic and effective learning.

Preliminary Data from Two Intervention Programs

This model for intervention has been followed with one ggroup of identified learning disabled college students and is underway with a group of "underachieving" 8th grade students. In each ease the students received an initial neruocogntive assessment similar to that in Table 1. This was followed by a "course" which focused on learning strtegies, representational alternatives and the development of metacognitive knowledge which could be used to improve learning processes and self-monitoring. In both cases the same neurocognitive data has been collected from a control group. The data from these two efforts are not complete, in the case of the 8th graders, and not fully analyzed, in the case of the college students. The remainder of this paper will report on preliminary overview of the experience and the data collected.

The one consistent powerful impression that all of us have gotten from working with neruocogntive assessment of individuals is the affect on them of viewing the visual grphic of their own brains in action. With both of these groups there were strong suspcisions that they were lacking brains or missing all the important parts. The affect of these people of seeing that their brain was basically all there and working in a pleasingly attractive fashion ranged from relief to the grounds for a striking self-reassessment. One college student had always thought of herself as a dumb blond who could never do anything except be a model. After looking at her brain data, and othe scores assessing her learning disability, she totally changed her attitude towward herself and her eductional potential. At the end of the course with the college students those of use who were fortuante enought to be involved in it were treated to some of the most stiring testimonials you would ever want to hear. These were people who had always been lead to believe that they were defective and they were now

saying things aobut how they could do anything if they just used their strengths. While such testimonies are quite grtifying, it remains for more exacting research to determine just what portion of the activity was able to produce these responses.

We are all very encouraged by the prospects for the use of topographic brain data as authoritative direct assessment of individual cogntive strengths and weaknesses. But before we can do this with just authority it will be necessary to assure ourselves that the assessments we are making are actualy indicative of learning processes related to educational success.

The next few brain maps are intended to suggest that the neurocognitive assessment measures important features of cognitive processing. Using a probe paradigm and integrating the assessed brain response over a relatively long time interval it is possible to get a picture of the relative involvement of areas of the brain in different approaches to the same task.

(Insert Figure 1 here)

These maps represet the relative involvement of areas of the brain of a skilled learning 8th grader using three differeny strategies to try to learn lists of words. The first map is of the individual trying to learn and remember the words by the use of an auditory code. The second map is the same persona about 2 minutes later trying to learn another list using a categorization strategy. The third map is another 2 minutes later when the individual tried to learn another list using a visual imagery strategy. The recall was virtually identical in all three cases. As can be seen the major idfference appears in the right frontal area during the visual imagery strategy. This individual is an extremely good spontaneous visual imager. It is worth nothing that this individual's performance did not show his strengths in this assessment, but his brain wave activity did.

(Insert Figure 2 here)

These three maps are of another 8th grade male doing the same three tasks in the same manner. Again note that the key issue is the difference in brain activity. This individual has identified learning disabilities. He has very poor auditory coding, very limited visual imagery, but is very good at doing analogies (which require the same types of skills that are necessary for the use of a categorization strategy. While this individual learned less of the words in each case than the other individual, his recall also did not differ fromm strategy to strategy.

The use of such neurocogntive assesssment is extremely new. These samples of the products are very preliminary. We are quite encouraged that with the accumulation of additional basic research on the relationship of brain electrical activity and educational tasks, it will be possible to use this technology both for helping educators understand learning processes and for helping individuals who are

Table 1

Brain Atlas Protocol-II

Subject_____

File #_____

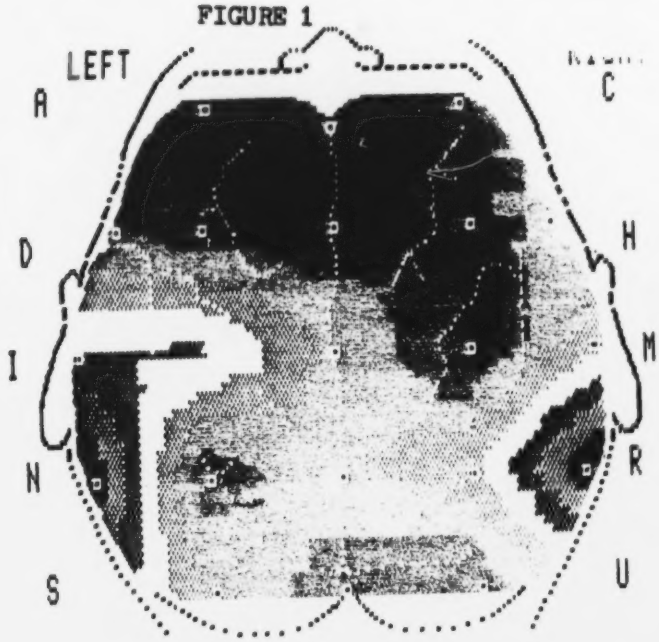
Disks_____

Disk #
1. EO
2. EO
3. EC
4. EC
5. Imagine Learning Well
6. Imagine Learning Poorly
7. Recall High School Friends
(names___faces___locations___activities___)
8. Solve a Maze
9. Draw a Person
10. Imagine Listening to Favorite Music
11. Free Write - Generate Words
12. Serial Subtraction
13. Memorization
14. Memorization
15. Oral Recall
16. Written Recall
17. Phonetic Spelling List
18. Non-Phonetic Spelling List

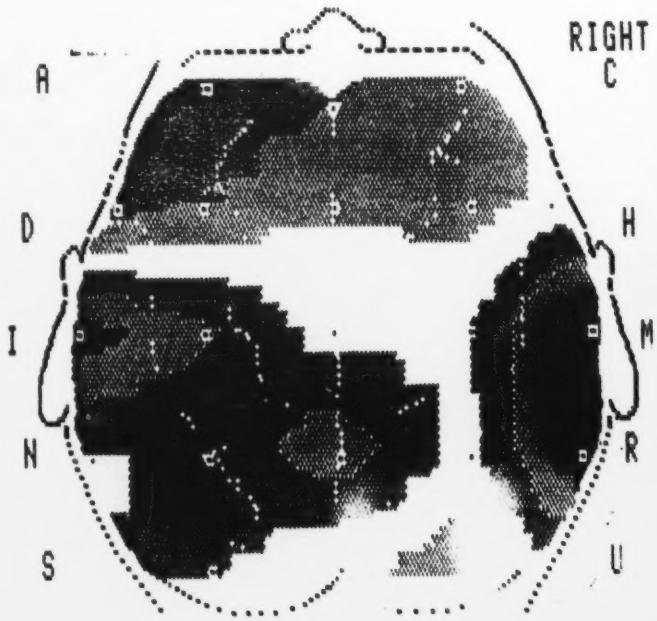
Disk #				
1. AEP P300 with no Stimulus 1	#1	#2	Subject	#R
2. AEP P300 Oddball	#1	#2	Subject	#R
3. AEP Baseline (S=100)	#R			

4. Reading - Probe
5. Reading - FFT
6. Reading Test - FFT
7. CFT - Probe
8. CFT - FFT
9. SM - Probe
10. SM - FFT
11. List Learning - Auditory - Probe
12. List Learning - Categories - Probe
13. List Learning - Visual Imagery - Probe
14. List Learning - Order - Probe
15. Stroop

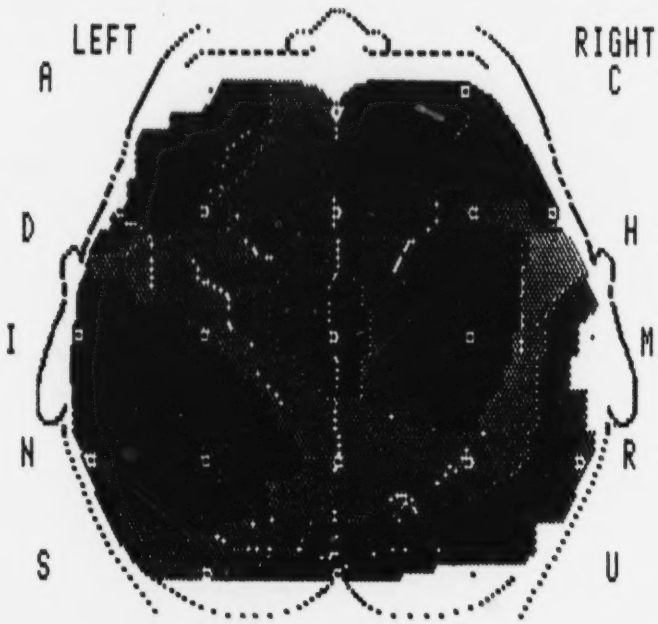
FIGURE 1



INTERVAL: 0.00 to 510.00 ms

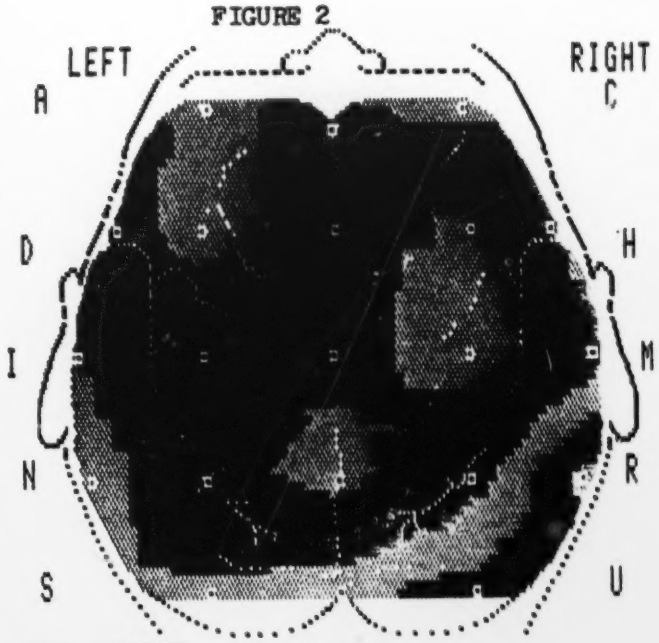


INTERVAL: 0.00 to 510.00 ms

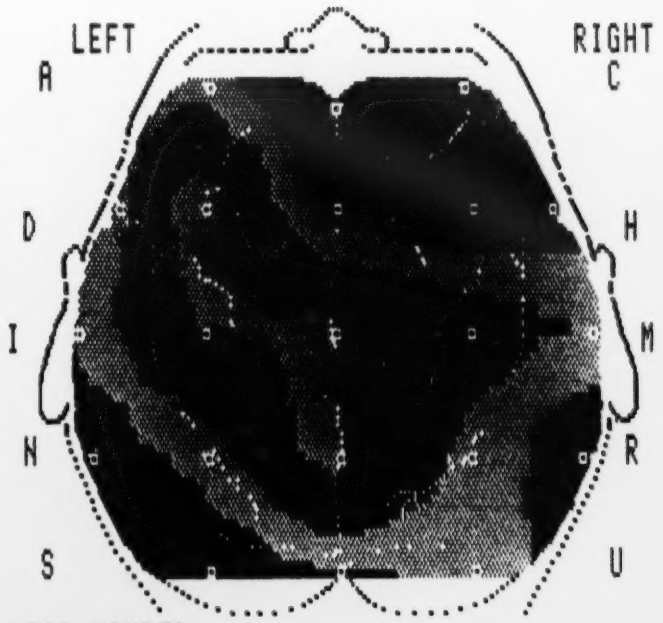


INTERVAL: 0.00 to 510.00 ms

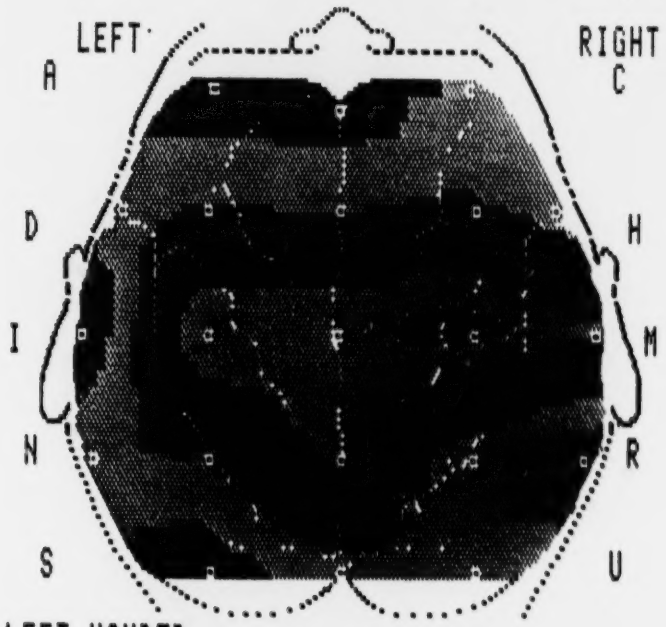
FIGURE 2



LEFT HANDED
INTERVAL: 0.00 to 510.00 ms



LEFT HANDED
INTERVAL: 0.00 to 510.00 ms



LEFT HANDED
INTERVAL: 0.00 to 510.00 ms

having difficulty with learning better understand and utilize their capaccities. Work by Shabsin has shown very encouraging results using biofeedback with the P300 wave and coordinate improvement in school performance. With the added power of topographic mapping technique we expect to see great promise for the development of biofeedback techniques as adjuncts to educational interventions.

We are continuing with data collectio and analysis, looking at basic learning processes and at the utilization of this information to assist in educational interventions.

Bibliography

Andrews, D. B. (1984), "Teaching Learning Skills: When and How Does it Work?" Presented at the New England Educational Research Organization Conference, Samoset, Maine.

Ashby, R. (1965), Design for a Brain: The Origin of Adaptive Behavior, 2nd Ed Rev., Science Paperbacks.

Bandura, A. (1971), Social Learning Theory, General Learning Press.

Biggs, J. B. (1984), "Learning Strategies, Student Motivation Patterns, and Subjectively Perceived Success." In, J. Kirby (ed), Cogntive Strategies and Educational Practice, Academic Press.

Fodor, J. (1983), The Modularity of Mind: An Essay on Faculty Psychology, MIT Press.

Gazzaniga, M. (1985), The Social Mind: Discovering the Networks of the Mind, Basic Books.

Heider, F. (1967), The Psychology of Interpersonal Relations, Wiley.

Kelley, H. H. (1967), "Attribution Theory in Social Psychology," in D. Levine (ed), Nebraska Symposium on Motivation, University of Nebraska Press.

Luria, A. R. (1973), The Working Brain: An Introduction to Neuropsychology, Basic Books.

Maslow, A. H. (1954), Motivation and Personality, Harper and Row.

McCombs, B. (1984), "Metacognition and Cognitive Components of Motivation: Teaching Self-Awareness and Self-Management via a Problem-Solving Approach," Presented at the American Educational Research Association Convention - Chicago.

Ornstein, P. and Naus, M. (1984), "The Influence of Knowledge Base on the Development of Mnemonic Strategies," Presented at the American Educational Research Association Convention, Chicago.

Ravitch, D. (1983), The Troubled Crusade: American Education 1945-1980, Basic Books.

Rotter, J. (1966), "Generalized Expectancies for Internal versus External Control of Reinforcement," Psychological Monographs, 80 (Whole No. 609).

Shabsin, H. (1982), "Feedback Controlled Increases in P300 Visual Evoked Potential Amplitudes and Neurological Functioning and Academic Performance in Learning Disabled Children," Dissertation Abstracts International, Vol.43 No.9, No. 9DA8303716, p.168.

Tversky, A. and Kahneman, D. (1978) "Causal Schemata in Judgments Unde Uncertainty," In, M. Fishbein(ed), Progress in Social Psychology, Erlbaum.

White, R. W. (1959), "Motivation Reconsidered: The Concept of Competence," Psychological Review, 66, pp297-333.